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EXAMINER	
LANDAU, MATTHEW C	

ART UNIT	PAPER NUMBER
2815	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

TH

Office Action Summary	Application No.	Applicant(s)	
	10/811,752	NEGLEY, GERALD H.	
	Examiner	Art Unit	
	Matthew C. Landau	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 July 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5 and 7-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-11 and 13-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 July 2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*. See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Drawings

The drawings were received on July 23, 2007. These drawings are acceptable.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 3-5, 8, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy (US Pat. 3,925,121) in view of Ogihara et al. (US Pat. 5,700,714, hereinafter Ogihara).

Regarding claims 1 and 5, Touchy discloses a p-type gallium nitride-based device comprising: a device structure that includes at least one p-type Group III nitride layer (GaN) (col. 2, lines 10-15 and 30-35) that includes some gallium; a first silicon dioxide layer on said p-layer (col. 2, lines 50-52); and a layer of a Group II metal source composition (containing Mg or Zn) on said first SiO_2 layer (col. 3, lines 1-4 and 31-33). Note that Touchy disclose the dopant material (diffusion source) may be deposited by a spin-on process (col. 3, lines 31-33), meaning the diffusion source (Mg or Zn composition) is in the form of a solid layer. The difference between Touchy and the claimed invention is a second silicon dioxide layer on said Group II metal source composition layer. Figure 5 of Ogihara discloses a SiO_2 cap layer 22 (col. 4, lines 3-5) over a diffusion source layer 20. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Touchy by

including a second SiO_2 layer over the diffusion source layer for the purpose of preventing escape of the diffusion impurity into the ambient space (col. 3, lines 37-41 of Ogihara).

Regarding claim 3, Touchy discloses the Group III elements (in this case Ga) and the group II metal elements diffuse through the protective layer (first SiO_2 layer) (col. 5, lines 16-29). Therefore, the first SiO_2 layer must be thick enough to create vacancies to a depth in said p-type layer that encourage atoms of said Group II metal to diffuse thereinto while still permitting diffusion from said Group II metal source composition.

Regarding claim 4, Touchy discloses the first SiO_2 layer is in the range of 500-1500 angstroms. Touchy does not specifically disclose the first SiO_2 layer is about 1000 angstroms thick, the Group II metal source composition layer is about 1000 angstroms thick, and the second SiO_2 layer is about 2500 angstroms thick. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify Touchy by selecting the claimed thickness values, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 8, it is inherent that the metal source composition layer of Touchy comprises some type of metal-containing compound.

Regarding claim 10, Touchy discloses the Group II metal source composition layer is GaN, which reads on the claim when x=1 and y=0 (col. 2, lines 30-35).

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy in view of Ogihara as applied to claim 1 above, and further in view of Edmond et al. (US Pat. 5,523,589, hereinafter Edmond).

Regarding claim 2, Touchy discloses the p-type semiconductor layer is used in an electro-luminescent semiconductor device (col. 1, lines 47-50). A further difference between Edmond and the claimed invention is the device comprises a conductive silicon carbide substrate; a conductive buffer layer on said silicon carbide substrate; and an n-type Group III nitride layer on said buffer layer. Figure 1 of Edmond discloses a light-emitting device comprising a SiC substrate 21, a conductive buffer layer 23 on said substrate; and an n-type Group III nitride layer 27 on said buffer. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Touchy by using the structure of Edmond for the purpose of fabricating a LED that can emit blue light and can be built in the vertical geometry (col. 3, lines 52-57 of Edmond).

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy in view of Ogihara, as applied to claim 1 above, and further in view of Iguchi et al. (US Pat. 6,214,708, hereinafter Iguchi).

Regarding claim 9, a further difference between Touchy and the claimed invention is the compound is selected from the group consisting of magnesium nitride and zinc phosphide. Iguchi discloses doping a III-V semiconductor with Zn by using zinc phosphide (col. 9, lines 48-52). In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Touchy by using zinc phosphide as the

diffusion source material for the purpose of selecting a well known diffusion source zinc compound.

Claims 11 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Touchy in view of Ogihara, as applied to claim 1 above, and further in view of Nobori et al. (US Pat. 6,291,328, hereinafter Nobori).

Regarding claim 11 and 13, a further difference between Touchy and the claimed invention is a plurality of silicon dioxide portions on said p-type Group III nitride layer, with a respective portion of said source composition on each said silicon dioxide portion. Figures 1 and 2 of Nobori discloses an array of LED's (shown as hatched portions in Figure 1), wherein each LED has a diffusion area 15 and a diffusion source layer 12 over the diffused area. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Touchy by having a plurality of separate diffusion areas, wherein each area is covered by a separate diffusion source layer. The ordinary artisan would have been motivated to modify Touchy in the manner described above for the purpose of fabricating a plurality of LED's on the same substrate. Regarding 13, it would also be obvious to have the second silicon dioxide layer (diffusion cap layer) covering said source composition portions and portions of the p-type Group III nitride layer as taught by Nobori (element 14 in Figure 2), for the purpose of simplifying the production process.

Claims 1, 2, 7, and 14-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Omi et al. (US Pat. 6,549,552, hereinafter Omi) in view of Touchy and Ogihara.

Regarding claims 1, 2, and 14, Figure 1 of Omi discloses a light emitting device comprising: a conductive silicon carbide substrate 1; a conductive buffer layer 2 on said silicon carbide substrate for provided a crystal transition between said substrate and said GaN portions of said device; an n-type GaN layer 3 on said buffer layer; and an Mg-doped p-type GaN layer 9 (col. 9, lines 14-16) on said n-type layer. A difference between Omi and the claimed invention is a first silicon dioxide layer on said p-type layer; a magnesium layer on said first SiO_2 layer for supplying p-type dopant to said p-type layer. Touchy discloses a method of p-doping a GaN layer wherein an intermediate product comprises at least one p-type Group III nitride layer (GaN) (col. 2, lines 10-15 and 30-35) that includes some gallium; a first silicon dioxide layer on said p-layer (col. 2, lines 50-52); and a layer of a Group II metal source composition (containing Zn or Mg) on said first SiO_2 layer (col. 3, lines 1-4 and 31-33). Note that Touchy disclose the dopant material (diffusion source) may be deposited by a spin-on process (col. 3, lines 31-33), meaning the diffusion source (Zn or Mg composition) is in the form of a layer. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Omi by doping the p-GaN layer using the method of Touchy, and therefore the intermediate structure of Touchy (comprising an SiO_2 layer over the p-GaN layer, and a diffusion source layer over the SiO_2 layer). Touchy also discloses the Group III elements (in this case Ga) and the group II metal elements diffuse through the protective layer (first SiO_2 layer) (col. 5, lines 16-29). Therefore, the first SiO_2 layer must be thick enough to create

vacancies to a depth in said p-type layer that encourage atoms of said Group II metal to diffuse thereinto while still permitting diffusion from said Group II metal source composition. The limitation "when said device is heated to temperatures between about 750 and 950 degrees" is merely a product-by-process limitation that does not structurally distinguish the claimed invention over the prior art. The ordinary artisan would have been motivated to modify Omi in the manner described above for the purpose of selecting inexpensive and well-known process for implanting Mg into the p-layer of Omi. A further difference between Omi and the claimed invention is a second silicon dioxide layer on said Group II metal source composition layer. Figure 5 of Ogihara discloses a SiO_2 cap layer 22 (col. 4, lines 3-5) over a diffusion source layer 20. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to further modify the invention of Touchy by including a second SiO_2 layer over the diffusion source layer for the purpose of preventing escape of the diffusion impurity into the ambient space (col. 3, lines 37-41 of Ogihara).

Regarding claims 7 and 15, Figure 1 of Omi discloses the substrate 1 is n-type (col. 4, lines 25-27). Further regarding claim 8, Omi does not specifically disclose the substrate has a carrier concentration of between about 1×10^{16} cm^{-3} and about 1×10^{19} cm^{-3}. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to further modify the invention of Omi by using a carrier concentration within the claimed range, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding claim 16, Figure 1 of Omi discloses the buffer layer 2 is a homogeneous layer of GaN (col. 4, lines 26-28).

Regarding claim 17, Figure 1 of Omi discloses the n-type layer 3 comprises AlGaN (col. 4, lines 28-30) (when y=0).

Regarding claim 18, Figure 1 of Omi discloses the p-type layer 9 comprises GaN (col. 4, lines 33-35) (when x=1 and y=0).

Allowable Subject Matter

Claim 12 is allowed.

The following is an examiner's statement of reasons for allowance: the prior art of record, either singularly or in combination, does not disclose or suggest the combination of limitations including said second silicon dioxide layer is limited to said source composition layer portions.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Response to Arguments

Applicant's arguments filed July 23, 2007 have been fully considered but they are not persuasive.

Applicant argues:

> "The cap of Ogihara is formed of a material that blocks the passage of atoms of the semiconductor substrate compound, such as Ga. An exemplary capping layer material is aluminum nitride. Column 3, lines 43-50. Yet, Touchy lists silicon dioxide as a material through which a Group III element (such as Ga) will diffuse. Accordingly, when considering the teachings of the patents in their entirety for all that they fairly teach, the skilled artisan would at best select an aluminum nitride cap for the Touchy device".

Applicant presented a similar argument in the response filed June 15, 2006. The Examiner responded to this argument in the Final rejection mailed August 22, 2006. Applicant has yet to address the Examiner's response to this argument. As stated in the above rejection, Ogihara specifically discloses the anneal cap layer can be SiO_2 (col. 4, lines 3-5). It was the SiO_2 cap layer that was incorporated into the device of Touchy. The potential to block impurities depends other factors besides just the type of material. For instance, the thickness of the layer plays a significant role in determining whether or not a layer will block impurities. Touchy clearly discloses the dopant impurities diffuse through the SiO_2 film (the film between the source composition and the substrate), and Ogihara clearly discloses the SiO_2 cap film 22 blocks diffusion. Since Ogihara specifically discloses the anneal cap layer can be SiO_2, there is no reason why the ordinary artisan would believe aluminum nitride must be used as the cap material when incorporated into the device of Touchy. Therefore, the motivational statement cited by the Examiner is valid and the 103 rejection is proper.

Applicant argues, "Omi does not teach or suggest diffusion doping process. As previously noted, the Omi device includes various layers that are already doped prior to the application to the substrate". Applicant presented a similar argument in the response filed June

15, 2006. The Examiner responded to this argument in the Final rejection mailed August 22, 2006. Applicant has yet to address the Examiner's response to this argument. The Examiner acknowledges that Omi does not teach a diffusion doping process, which is why it was combined with Touchy. The point of the above 103 rejection was to use the dopant diffusion process of Touchy to dope layer 9 of Ohmi. In other words, instead of deposited layer 9 as an in-situ doped layer, the proposed combination would first deposit layer 9 undoped, then use the solid-state diffusion process of Touchy to implant p-type dopants. The proposed combination would make an intermediate product, wherein the additional dopant source layer could be subsequently removed.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew C. Landau whose telephone number is 571-272-1731. The examiner can normally be reached on 9:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew C. Landau
Primary Examiner
Art Unit 2815
10/9/07